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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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| **Applicant:** | Collins et al. | **Examiner:** | Lee, Hsien Ming |
| **Serial No.:** | 10/695,843 | **Group Art Unit:** | 2823 |
| **Filed:** | October 29, 2003 | | |
| **For:** | SPIN COATING METHODS AND APPARATUSES FOR SPIN-COATING, INCLUDING PRESSURE SENSOR | **Docket No.:** | FSI0052/US/2 |

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I CERTIFY THAT ON June 30, 2006, THIS PAPER IS BEING DEPOSITED WITH THE U.S. POSTAL SERVICE AS FIRST CLASS MAIL IN AN ENVELOPE ADDRESSED TO MAIL STOP APPEAL BRIEF-PATENTS, COMMISSIONER FOR PATENTS, P.O. BOX 1450, ALEXANDRIA, VA 22313-1450

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~~01 FC:1401 500.00 OP~~

# APPEAL BRIEF

Dear Sir or Madam:

This Appeal Brief is being submitted in support of an Appeal from the Final Rejection mailed February 3, 2006, in connection with the above-identified patent application. Enclosed is a fee in the amount of $500.00 for filing the Appeal Brief.

A Notice of Appeal was received in the Patent Office on May 5, 2006. It is respectfully submitted that this Appeal Brief is timely filed within two months from actual receipt of the Notice of Appeal.

It is believed that no extension of time is required in order for this paper to be timely filed. However, if any extension period is required in order for this paper to be timely filed, then Applicants hereby request an extension for such additional time period and authorize the appropriate fee(s) therefore to be charged to the Kagan Binder Deposit Account No. 50-1775 and notify us of the same.

It is believed that no other fee(s) are required in filing this paper. However, if any other fee(s) are required, then Applicants hereby authorize such fee(s) therefore to be charged to the Kagan Binder Deposit Account No. 50-1775 and notify us of the same.

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## Table of Contents

## I. Real Party in Interest

FSI International, Inc., the assignee of record, is the real party in interest.

## II. Related Appeals and Interferences

There are no related appeals or interferences.

## III. Status of Claims

Claims 16-31 have been canceled.

Claims 1-15 are pending.

Claims 1-8 stand rejected under 35 U.S.C. §102 (e) as being anticipated by Mekias (U.S. Pub. No. 2003/0075555).

Claims 9-15 stand rejected under 35 U.S.C. §103(a) as being unpatentable over DeSimone et al. (U.S. Pat. No. 6,383,289) in view of Hayes et al. (U.S. Pat. No. 6,494,953).

All of these rejections of claims 1-15 are appealed.

## IV. Status of Amendments

The status of amendments filed subsequent to final rejection is discussed below.

A. Claim 24 was amended and claim 30 was canceled in the Amendment After Final Office Action filed on April 3, 2006. Claim 24 was amended to incorporate the subject matter of dependent claim 30 and to clarify claim language. Per the Advisory Action mailed April 20, 2006, these amendments were not entered.

B. Claims 24-27, 30, and 31 were canceled in the Second Amendment After Final Office Action filed on May 3, 2006. Per the Advisory Action mailed May 12, 2006, these amendments were entered.

## V. Summary of Claimed Subject Matter

***Note: the parenthetical citations below refer to the Applicants' specification.***

**Independent Claim 1**

Claim 1 is directed to a spin-coating system including, *inter alia*, a control feature recited as "a pressure sensor that measures pressure of the process solution in the dispense line at a time related to a step of dispensing the process solution, to control timing of a subsequent spin-coating process step" (see, e.g., page 12, lines 12-20)(underlining added for emphasis). As featured in dependent claim 4, a preferred time related to a step of dispensing a process solution includes a beginning or end of process solution being dispensed from the dispenser (see, e.g., page 12, lines 16-19). For example, the end of photoresist solution dispense as determined by measuring the pressure of the photoresist solution can be used to control the timing of a subsequent spin-coating process step such as, e.g., moving a dispenser and/or changing the turntable spin speed (e.g., changing the spin speed to casting speed) (see, e.g., page 29, lines 1-25 and page 30, lines 25-31).

**Independent Claim 9**

Claim 9 is directed to a spin-coating system including, *inter alia*, a control feature recited as "a process control system that controls application of the process solution to the substrate, the process control system being programmed to interrupt serial control to execute a process command" (see, e.g., page 12, lines 21-29)(underlining added for emphasis).

Advantageously, interrupting serial process control to execute a spin-coating process command according to claim 9 can reduce or eliminate variations in timing associated with serial process control (see, e.g., page 5, lines 5-15). Serial process control can introduce timing variations because process parameters are addressed sequentially through a series of subroutines in a predetermined, fixed fashion (see, e.g., page 6, lines 24-26). For example, serial process control may be addressing other subroutines when solution dispense ends and, therefore, does not execute a process command subsequent to dispense (e.g. change turntable spin speed) until the other subroutines have been addressed (see, e.g., page 7, lines 7-22). Such variation in timing associated with the execution of process commands using serial process control can cause

significant variations in, e.g., thickness and uniformity of process solution coating, and line-width repeatability (see, e.g., page 7, line 23 to page 8, line 3).

## VI. Grounds of Rejection to be Reviewed on Appeal

A. A first issue on appeal concerns whether claims 1-8 are novel under 35 U.S.C. §102(e) over Mekias.

B. A second issue on appeal concerns whether claims 9-15 are patentable under 35 U.S.C. §103(a) over DeSimone et al. in view of Hayes et al.

## VII. Argument

**A. Claims 1-8 are novel under 35 U.S.C. §102 (e) over Mekias.**

Claims 1-8 are novel over Mekias because Mekias does not teach each and every element of claim 1. For example, Mekias does not teach the control feature recited in claim 1.

MPEP 2131 properly indicates that to anticipate a claim, the reference must teach each and every element as set forth in the claim.

As mentioned in the Summary of Claimed Subject Matter, the control feature of claim 1 includes a pressure sensor that measures the pressure of a process solution in the dispense line at a time related to a step of dispensing the process solution, to control timing of a subsequent spin-coating process step. For example, the end of photoresist solution dispense as determined by measuring the pressure of the photoresist solution can be used to control the timing of a subsequent spin-coating process step such as, e.g., moving a dispenser and/or changing the turntable spin speed (e.g., changing the spin speed to casting speed) (see the specification at, e.g., page 29, lines 1-25 and page 30, lines 25-31).

Mekias does not teach a spin-coating system that includes a pressure sensor that measures the pressure of a process solution in a dispense line at time related to solution dispense to control the timing of a subsequent spin-coating process step.

The Mekias reference relates to a high precision fluid dispensing apparatus, i.e., a high precision pump (see Mekias at, e.g., paragraphs 0001 and 0005). Applicants note their familiarity with the Mekias reference as the Mekias reference is assigned to the same assignee of the present patent application (Assignee is FSI International, Inc.).

Mekias discloses pressure sensors and that such pressure sensors can measure the pressure of a process fluid to control the process fluid pressure in the Mekias pump via feedback control (see Mekias at paragraph 0023). Feedback control is well-known to involve measuring an output parameter of a process (e.g., fluid pressure), comparing the measured value to an expected value, making a decision based on the comparison, and, depending on the decision, actuating a device to control the input process parameter (e.g., fluid pressure) (see, e.g., Ogunnaike et al., Process Dynamics, Modeling, and Control, at pages 17 and 18 (1994) (copy enclosed )).

So, using pressure sensors for feedback control of process fluid pressure according to Mekias would involve measuring the process fluid pressure at an "output" point, comparing the measured process fluid pressure to an expected process fluid pressure, and making a decision based on the comparison. Depending on the decision made, a device at an "input" point may be actuated to control the process fluid pressure, **not** necessarily to control the timing of a subsequent spin-coating process step, as claimed.

Accordingly, it is respectfully requested that the rejection of claims 1-8 under 35 U.S.C. §102 (e) as being anticipated by Mekias, be withdrawn.

**B. Claims 9-15 are patentable under 35 U.S.C. §103(a) over DeSimone et al. in view of Hayes et al.**

Claims 9-15 are patentable over DeSimone et al. in view of Hayes et al. because DeSimone et al. in view of Hayes et al. does not establish a prima facie case of obviousness. For example, Desimone et al. and Hayes et al., alone or in combination, do not teach, motivate, or suggest the control feature of independent claim 9.

MPEP 2143 properly indicates that:

> To establish a prima facie case of obviousness... the prior art reference (or references when combined) must teach or suggest all the claim limitations.

And MPEP 2142 properly indicates that:

> The examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness.

As mentioned in the Summary of Claimed Subject Matter, the control feature of claim 9 recites a "a process control system that controls application of the process solution to the substrate, the process control system being programmed to interrupt serial control to execute a process command" (underlining added for emphasis). This control feature of claim 9 is considered unique and advantageous in that it can reduce or eliminate variations in timing associated with serial process control used to control application of a process solution (see the specification at, e.g., page 5, lines 5-15). For example, serial process control may be addressing other subroutines when a solution dispense ends and, therefore, does not execute a process

command subsequent to dispense (e.g. change turntable spin speed) until the other subroutines have been addressed (see, e.g., page 7, lines 7-22).

DeSimone et al. fail to teach a process control system that includes interrupting serial control to execute a process command, especially in the context of controlling the application of a process solution. DeSimone et al. disclose that their process liquid, carbon dioxide liquid, is in fluid communication with dispenser 17 and is merely "under control of valve 32." (See DeSimone et al. at col. 3, lines 13-18, and col. 5, lines 9-20). DeSimone et al. also disclose that the shape or rate of the carbon dioxide liquid can be controlled by modifying nozzle 19 (see DeSimone et al. at col. 3, lines 41-58). However, DeSimone et al. do not disclose controlling application of the carbon dioxide liquid using serial process control, much less using the unique control feature of interrupting serial control to execute a process command, as claimed.

It is noted that the Office Action cites to the following passage in DeSimone et al. with respect to the control of the application of a process solution to a substrate:

> The fluid barricade, robotic arm, grasping member, and shuttle cars may be driven by standard drive techniques and the operation thereof coordinated with a controller, such as a programmable computer, in accordance with standard techniques. (See DeSimone et al. at col. 6, lines 21-26) (See also page 4 of the Office Action mailed August 30, 2005, and page 5 of the Office Action mailed February 3, 2006).

However, concluding that this passage in DeSimone et al. relates to the control of the application of a process solution to a substrate is based on a misunderstanding of DeSimone et al.

The Office Action misconstrues what items DeSimone et al. disclose as being controlled with a programmable computer. Contrary to the position of the Office Action, the above passage of DeSimone et al. does not describe controlling application of carbon dioxide liquid or any other process solution. The above passage in DeSimone et al. discusses how the "fluid barricade, robotic arm, grasping member, and shuttle cars" can be controlled.

Accordingly, concluding that DeSimone et al. necessarily teaches the unique control feature of claim 9 is factually unsupported in the record and, therefore, cannot support a conclusion of obviousness.

DeSimone et al. fail to suggest or motivate the control feature of claim 9. Indeed, DeSimone et al. fail to disclose controlling the application of a process solution with even serial

process control (discussed above). So, there is no motivation or suggestion to interrupt serial control to execute a process command especially when serial process control is not even disclosed as being used with respect to the dispensing of carbon dioxide liquid.

The secondary reference, Hayes et al., fails to cure the deficiencies of the DeSimone et al. reference. That is, Hayes et al. fail to teach, motivate, or suggest a process control system that controls application of a process solution and includes interrupting serial control to execute a process command. Hayes et al. do not even mention controlling the application of a process solution using serial process control. Indeed, the Office Action merely relied on the Hayes et al. reference for disclosing a nozzle that was moveable between a dispense position and a non-dispense position (see page 4 of the Office Action mailed August 30, 2005).

Accordingly, it is respectfully requested that the rejection of claims 9-15 under 35 U.S.C. §103(a) as being unpatentable over DeSimone et al. in view of Hayes et al., be withdrawn.

In view of these remarks, it is respectfully submitted that pending claims 1-15 are in condition for allowance.

Respectfully Submitted,

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Dated: June 30, 2006

#26948

## VIII. Appendix – Claims

1. (original) A spin-coating system comprising a supply of process solution in fluid communication with a dispenser through a dispense line, and a pressure sensor that measures pressure of the process solution in the dispense line at a time related to a step of dispensing the process solution, to control timing of a subsequent spin-coating process step.

2. (original) The system of claim 1 wherein the pressure sensor comprises a pressure transducer.

3. (original) The system of claim 1 comprising a dispense valve between the supply of process solution and the dispenser, and the pressure sensor is between the dispense valve and the dispenser.

4. (original) The system of claim 1 wherein the pressure sensor detects a beginning or end of process solution being dispensed from the dispenser.

5. (original) The system of claim 1 further comprising a control system for controlling a spin-coating process, wherein the pressure sensor detects a beginning or end of process solution dispense from the dispenser, and the pressure sensor sends a signal to the control system at a detected beginning or at a detected end of process solution dispense.

6. (original) The system of claim 5 wherein the process solution is a photoresist solution and the pressure sensor signals the control system at a detected end of photoresist solution dispense.

7. (original) The system of claim 5 wherein the process solution is a developer solution and the control pressure sensor signals the control system at a detected start of developer solution dispense.

8. (original) The system of claim 1 wherein the process solution is selected from the group consisting of a photoresist, a developer, a solvent, and deionized water.

9. (original) A spin-coating system comprising:

a turntable to support and rotate a substrate;

a dispenser moveable between a dispensing position and a non-dispensing position;

a supply of process solution in fluid communication with the dispenser through a dispense line;

a pressure sensor that measures pressure of the process solution;

a process control system that controls application of the process solution to the substrate, the process control system being programmed to interrupt serial control to execute a process command.

10. (previously presented) The system of claim 9 wherein

the system comprises a dispense valve between the supply of process solution and the dispenser,

the pressure sensor measures pressure of the process solution in the dispense line, and

the pressure sensor is between the dispense valve and the dispenser.

11. (original) The system of claim 9 wherein the process solution is chosen from the group consisting of a photoresist solution and a developer solution.

12. (original) The system of claim 9 wherein the pressure sensor sends a signal to the control system at the beginning or the end of dispense of the process solution, and the control system interrupts control of the process.

13. (original) The system of claim 12 wherein the process solution is a photoresist solution and the pressure sensor sends a signal to the control system at an end of photoresist solution dispense.

14. (original) The system of claim 12 wherein the process solution is a developer solution and the pressure sensor sends a signal to the control system at the start of developer solution dispense.

15. (original) The system of claim 9 wherein the process solution is selected from the group consisting of a photoresist, a developer, deionized water, and a solvent.

16-31. (canceled)

## IX. Appendix - Evidence

Attached hereto is a copy of four (4) pages of Ogunnaike et al., Process Dynamics, Modeling, and Control (1994). A copy these pages of the Ogunnaike et al. reference was entered in the record with Applicants' previous Reply to illustrate what feedback control is and that feedback control is well-known (see pages 7 and 8 of Applicants' Reply filed April 3, 2006).

# process dynamics, modeling, and control

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control valves (usually pneumatic, *i.e.*, they are air-driven), and they occur in various shapes, sizes, and have several modes of specific operation. Some other examples of final control elements include: *variable speed fans, pumps, and compressors; conveyors; and relay switches.*

### *Other Hardware Elements*

In transmitting information back and forth between the process and the controller, the need to *convert* one type of signal to another type is often unavoidable. For example, it will be necessary to convert the electrical signal from an electronic controller to a pneumatic signal needed to operate a control valve. The devices used for such signal transformations are called *transducers,* and as will be further discussed in Chapter 2, various types are available for various signal transformations.

Also, for computer control applications, it is necessary to have devices known as *analog-to-digital* (A/D) and *digital-to-analog* (D/A) *converters.* This is because, as will be elaborated further in Chapter 2, while the rest of the control system operates on *analog* signals (electric voltage or pneumatic pressure), the computer operates *digitally,* giving out, and receiving, only binary numbers. A/D converters make the process information available in recognizable form to the computer, while the D/A converters make the computer commands accessible to the process.

## 1.4.2 Control System Configuration

Depending primarily upon the structure of the decision-making process in relation to the information-gathering and decision-implementation ends, a process control system can be configured in several different ways. Let us introduce some of the most common configurations.

### *Feedback Control*

The control system illustrated in Figure 1.12 operates by *feeding* process output information *back* to the controller. Decisions based on such "fed back" information is then implemented on the process. This is known as a *feedback control structure,* and it is one of the simplest, and by far the most common, control structures employed in chemical process control. It was introduced for the furnace example in Figure 1.6(a).

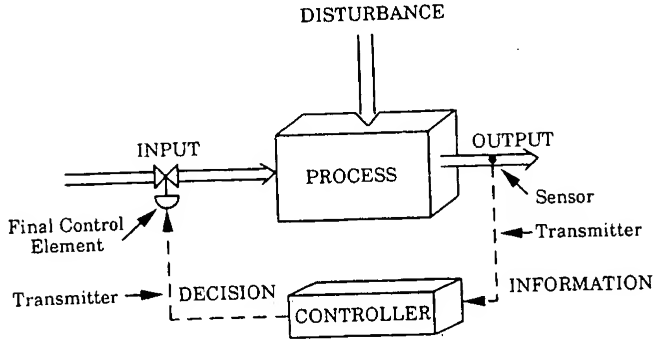


**Figure 1.12.** The feedback control configuration.

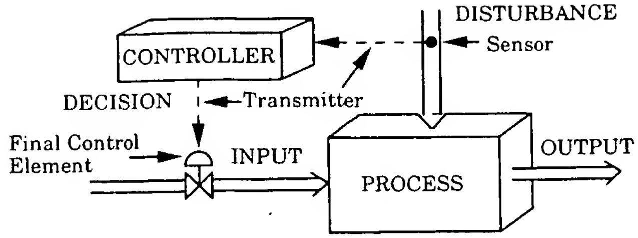


**Figure 1.13.** The feedforward control configuration.

It is important to point out the intuitively appealing nature of this control structure. Observe that it makes use of *current* information about the output of the process to determine what action to take in regulating process behavior. We must note, however, that with such a structure, the effect of any disturbance entering the process must first be registered by the process as an upset in its output before corrective control action can be taken; *i.e.*, controller decisions are taken "after the fact."

## *Feedforward Control*

In Figure 1.13 we have a situation in which it is information about an incoming disturbance that gets directly communicated to the controller instead of actual system output information. With this configuration, the controller decision is taken *before* the process is affected by the incoming disturbance. This is the *feedforward control* structure (compare with Figure 1.12) since the controller decision is based on information that is being "fed forward." As we shall see later, feedforward control has proved indispensable in dealing with certain process control problems.

The main feature of the feedforward configuration is the choice of measuring the *disturbance* variable rather than the output variable that we desire to regulate. The potential advantage of this strategy has already been noted. Further reflection on this strategy will, however, also reveal a potential drawback: the controller has *no information* about the conditions existing at the process output, the actual process variable we are concerned about regulating.

Thus the controller detects the entrance of disturbances and before the process is upset attempts to compensate for their effects somehow (typically based on an imperfect process model); however, the controller is unable to determine the accuracy of this compensation, since this strategy does not call for a measurement of the process output. This is often a significant disadvantage as was noted in Section 1.2.

## *Open-Loop Control*

When, as shown in Figure 1.14, the controller decision is *not* based upon any measurement information gathered from any part of the process, but upon some sort of internally generated strategy, we have an *open-loop control structure.* This is because the controller makes decisions *without* the advantage of

## X. Appendix - Related Proceedings

None.